Chapter 5
Long Bay Subbasin

Part of Hydrologic Unit Code: 03040208

General Description

Long Bay subbasin is located entirely within the Brunswick County borders (Figure 5-1). It lies mainly in the poorly drained flatwoods ecoregion of the coastal plain but also has barrier islands, coastal marshes, and swampy peat lands. Most of the barrier islands that line the coast have been completely developed with one exception. Bird Island was purchased by the state of North Carolina and added to the National Estuary Research Reserve. This area serves as one of North Carolina's biggest vacation destinations.

Watershed at a Glance

COUNTIES
Brunswick

MUNICIPALITIES
Boiling Spring Lakes, Bolivia, Calabash, Carolina Shores, Holden Beach, Saint James, Shallotte, Sunset Beach Varnamtown

PERMITTED FACILITIES

NPDES Wastewater Discharge	
Major:	0
Minor:	2
NPDES Nondischarge:	8
NPDES Stormwater	
General:	22
State:	157
Animal Operations:	3

AQUATIC LIFE SUMMARY

Monitored:	26 Miles 1,640 Acres
Total Supporting:	13 Miles 1,305 Acres
Total Impaired:	13 Miles 411 Acres
Total Not Rated:	0 Miles 0 Acres

Current Status and Significant Issues

There are only two remaining NPDES discharge permits in this subbasin both of which are oyster processing facilities on the Shallotte River. All the facilities that treat wastewater in the subbasin have non-discharge permits and utilize infiltration ponds and spray fields. The treated water is usually sprayed on one of the many golf courses in the area.

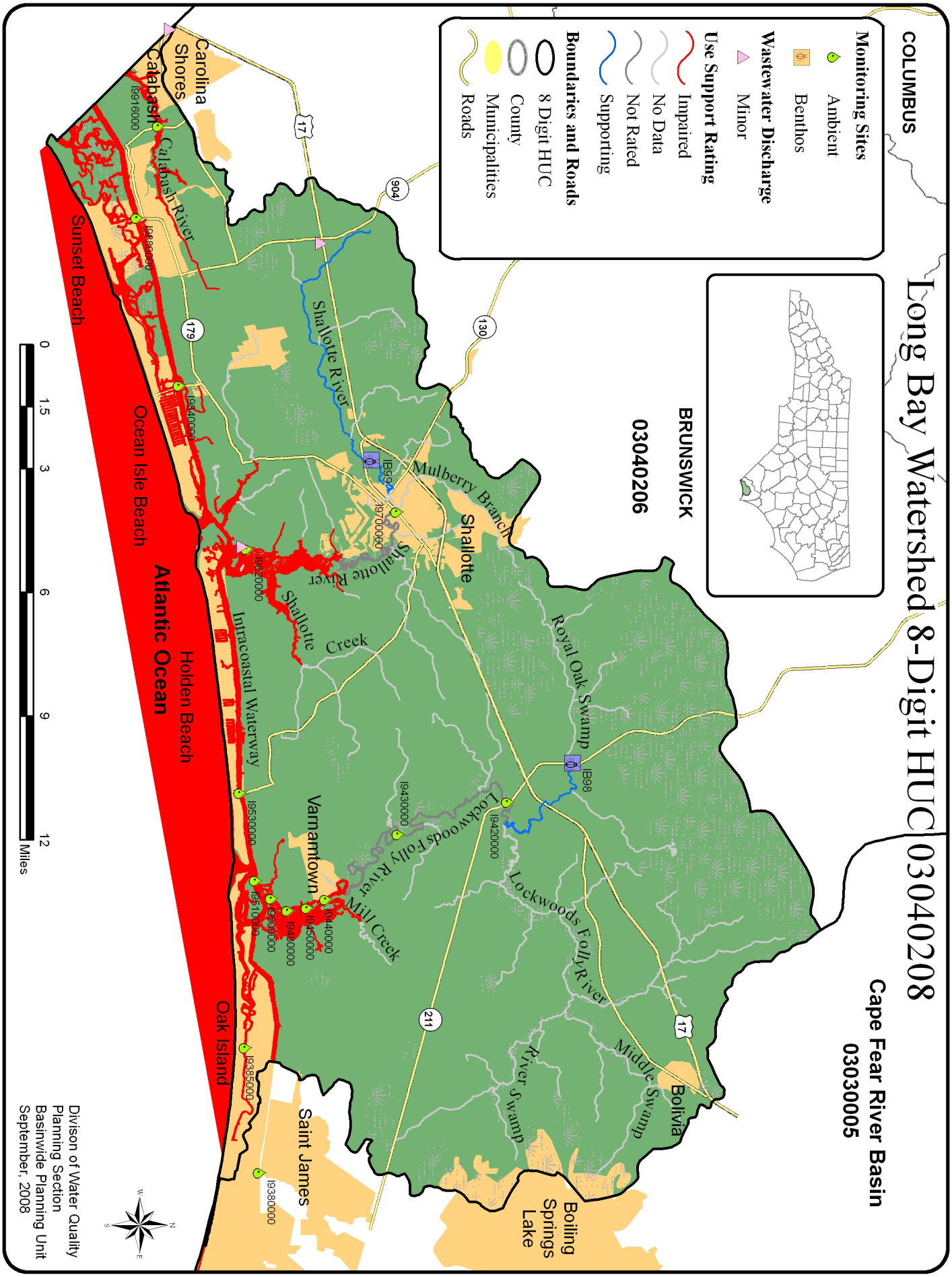
The Lockwoods Folly Water Quality Management Plan (15A NCAC 02B.0227) places tighter water quality standards on the Lockwoods Folly River South of Genoes Point and Mullet Creek. Assessment units subject to these rules are denoted in Appendix B Use Support Tables by an @ symbol.

The Division of Coastal Management is currently reviewing CAMA Land Use Plan drafts for Brunswick County, Calabash, Holden Beach, Ocean Isle Beach and Shallotte as required by 15A NCAC 07B. There is a certified plan for Varnamtown. These plans should stress strong support for low impact development, stormwater controls and conservation easements in order to protect and restore water quality.

New coastal stormwater rules known as Session Law 2008-211 went into effect on October 1, 2008 place stricter stormwater standards on Brunswick County and 19 other coastal counties. Upon implementation, these rules should reduce fecal coliform bacteria from future developments. Further reduction for existing development is needed to ensure the survival of the shellfishing and tourism industries in Brunswick County.

This area contains limestone formations called karst that are susceptible to sinkhole development which creates engineering hazards. Rainwater mixes with carbon dioxide in the air to make carbonic acid that slowly dissolves the limestone creating either a depression or an underground cave. This is hazardous to both domestic and commercial development and can lead to costly damages. These hazards increase if stormwater is allowed to flow through such formations increasing the weathering effects.

FIGURE 5-1: LONG BAY/COASTAL CAROLINA SUBBASIN (03040208)



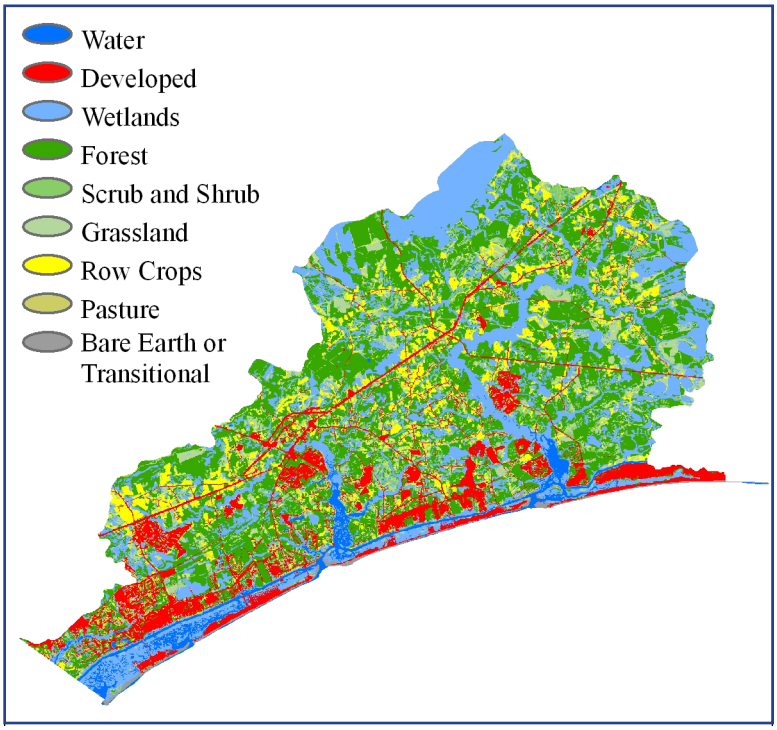
Salt water intrusion can create problems for people who obtain their water from groundwater aquifers. If groundwater aquifers become contaminated with saline water, then it places greater strain on surface water supplies.

Population and Land Use

Population for this subbasin is estimated at 34,632 or 137 people per square mile based on the 2000 census. However, Brunswick county has been one of the fastest growing counties in the nation in recent years. In addition to the growing permanent population, the US census does not account for seasonal population changes related to vacation homes and tourism. Even without adjusting for seasonal population this is still the most densely population subbasin in the Lumber River basin.

The amount of developed land in this subbasin based on 2001 data is over 12 percent. It is the most impervious subbasin in the Lumber River basin. This area has experienced very rapid growth since 2001 and much more development has been planned so the amount of land currently developed is probably greater than 12 percent. Forest remains the dominant land cover at over 34 percent, while wetlands are second at over 26 percent of the land cover (Figure 5-2).

Figure 5-2: Long Bay Subbasin Land Use Based on the 2001 National Land Cover Dataset



Ambient Water Quality

There are no freshwater ambient monitoring sites in the subbasin; however 15 saltwater sites were sampled. Six of these amibient sites were dropped in July of 2002. All active ambient monitoring site in the Long Bay subbasin exceeded at least one water quality standard. The most common exceedance was dissolved oxygen with six sites below the standard. Fecal coliform counts exceeded the screening criteria at five locations including the Calabash River which exceeded the shellfish standard of 43 colonies/100 mL over 86 percent of the time. Other parameters exceeded consist of low pH, turbidity, and copper. With only two discharge permits and little agriculture, the most likely cause of ambient standards exceedances is stormwater runoff.

General Biological Health

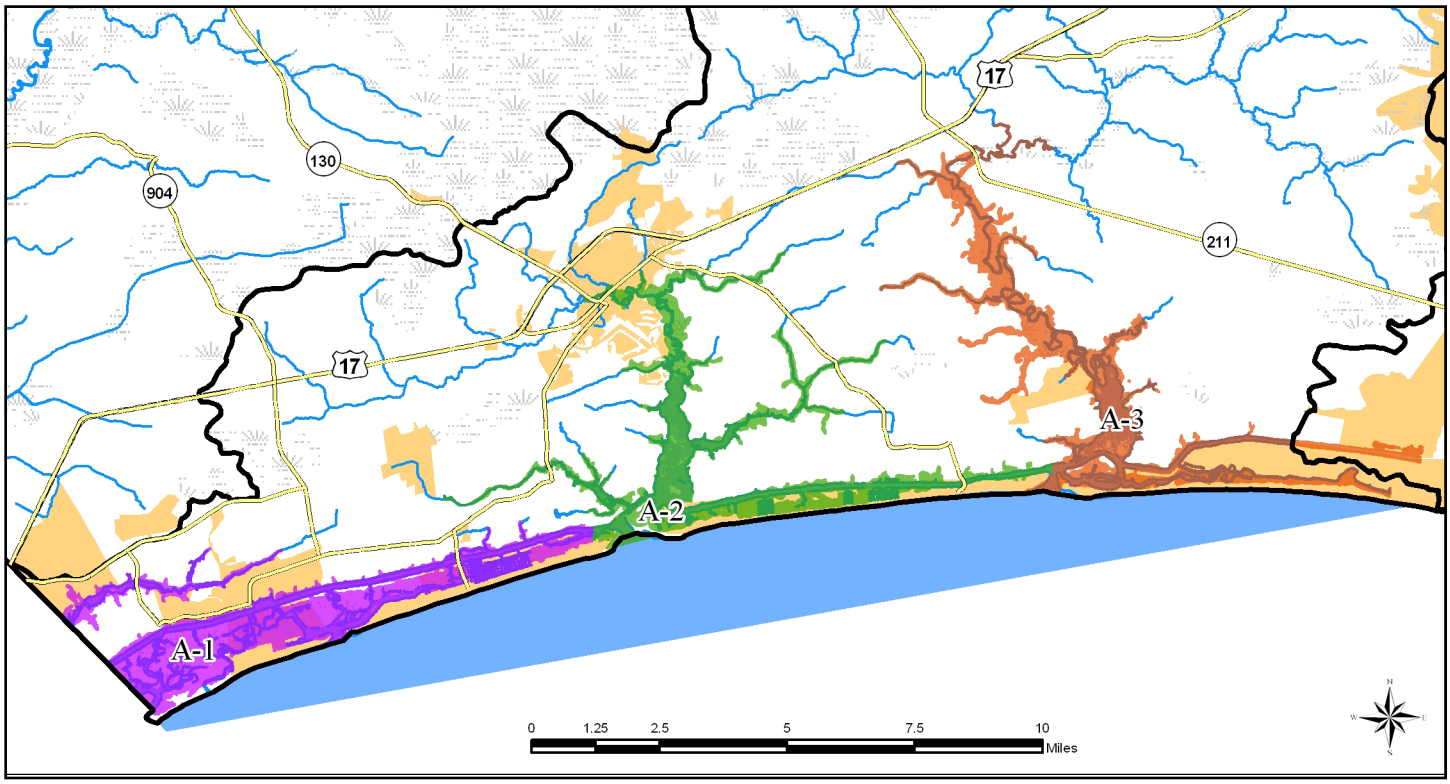
There is a lack of freshwater biological data from the watershed to determine the overall biological health in the subbasin. Only two stations were sampled for benthic macroinvertebrates during the assessment period. One station received a Natural bioclassification rating while the other was rated Good-Fair. The benthic sites for the Shallotte River and Lockwoods Folly River near US Highway 17 have been removed from regular sampling because of saltwater intrusion. Another benthic site in the headwater of Lockwoods Folly was not sampled in 2001 or 2006 due to insufficient flow. Many of the smaller tributaries have no flow in the summer thus benthic macroinvertebrate sampling is often done in the winter.

Division of Environmental Health Recreational Water Quality Program

The N.C. Recreational Water Quality Program began testing coastal waters in 1997. This program tests 40 swimming sites in the Long Bay watershed for enterococcus bacteria and issues swimming advisories in order to protect human health. Most recreational monitoring sites are tested on a weekly basis during the swimming

season, which runs from April 1 to October 31. DEH divides these site into 3 tiers with tier 1 having the most strict standards because they are used most frequently by swimmers. There were 7 swimming advisories proclamations in the basin between 2002 and 2008. Two of these advisories were basinwide and were associated with hurricanes. All waterbodies assessed for recreation are considered Supporting.

Figure 5-3: Shellfish Growing Areas in the Lumber Basin



Division of Environmental Health Sanitary Shellfish Program

The North Carolina State Division of Environmental Health (DEH) is responsible for classifying coastal waters as to their suitability for shellfish harvesting, monitoring and issuing advisories for shellfish closures. DEH assess the level of enterococcus or fecal coliform bacteria in the water column. These bacteria are found in the intestines of warm-blooded animals. While they do not cause illness themselves, scientific studies indicate that enterococci and fecal coliform bacteria may indicate the presence of other disease-causing organisms. As the area has grown and stormwater runoff has increased the status of growing areas are trending toward conditionally approved closed or prohibited. There are three shellfish growing areas located entirely or partially within the Long Bay watershed (Figure 5-3). All waters classified as SA in the watershed are considered impaired for shellfish harvesting due to high bacteria levels from stormwater runoff.

Growing Area A-1

Area A-1 extends from the state border to channel marker #84 west of Shallotte Inlet. Traditionally this area has been heavily harvested for clams and oysters, but recent declines in water quality have led to further shellfish area closures (Table 5-1). Some of these closures are permanent while other are rainfall dependent. A report released by the DEH in February 2006 attributes the water quality declines to stormwater runoff based on a comprehensive shoreline survey conducted in 2003. The Conditional Area Management Plan for this area states that Conditionally Approved Open (CAO) areas be immediately closed following a rainfall event of 1 inch or greater in a 24 hour period. The area remains closed until there are adequate water samples that show acceptable bacteria levels. Conditionally Approved Closed (CAC) area may only be opened to shellfish harvesting during very dry period and after water quality testing has been completed. These areas are monitored frequently while open and are immediately closed after a 0.5 inch rainfall event in a 24 hour period.

Growing Area A-2

Area A-2 consists of the Shallotte River and its tributaries, Saucepan Creek and its tributaries, and the Intercoastal Waterway from Channel Marker #82 to Flashing Beacon #47. The January 2006 Report of Sanitary Survey of growing area A-2 concluded that water quality in the area is continuing to decline resulting in further closures of shellfish harvesting waters. Similar to growing area A-1 the main source of pollution in the area is stormwater runoff from new and existing development. The CAO section of the Shallotte River is immediately closed following a rainfall event of 1.5 inches in a 24 hour period. The same is true for the CAO sections of the Intercoastal Waterway after a rainfall event of 2.5 inches in a 24 hour period.

Growing Area A-3

Growing area A-3 is composed of Lockwoods Folly River, its tributaries, Montgomery Slough, and the Intracoastal Waterway between flashing beacon #51 and flashing beacon #16. The latest Report of Sanitary Survey for this growing area continues to show numerous closures related mainly to stormwater runoff. However, it also reports a net gain of 8 acres being reclassified from Prohibited to Conditionally Approved Open.

Rapid development is still occurring in the Lockwoods Folly Watershed which potentially will lead to further shellfish closures if Low Impact Development (LID) practices are not implemented. Many Conditionally Approved Open areas are closed following rainfall events of greater than 0.5 inch in a 24 hour period or 0.75 inch in a 48 hour period. Other areas have higher thresholds and will be closed after 1.0 inch or in some cases 2.0 inches of rainfall in a 24 hour period.

Table 5-1: Shellfish Growing Area Classification by Assessment Unit

Assessment Unit Number	Name	Growing Area Classification	Subwatershed	Growing Area
15-25-3	Big Gut Slough	CAO	030402080303	A-1
15-25-4	Killbart Slough	Prohibited	030402080204	A-1
15-25-5	Gause Landing Creek	Prohibited	030402080204	A-1
15-25-6	Eastern Channel	CAO; CAC	030402080303	A-1
15-25-6-1	Clam Creek	CAC	030402080303	A-1
15-25-7	Sols Creek	CAC	030402080303	A-1
15-25-8	Still Creek	CAC; CAO	030402080303	A-1
15-25-9	Jinks Creek	CAC	030402080303	A-1
15-25-9-1	Cooter Creek	CAC	030402080303	A-1
15-25-10	The Big Narrows	CAC	030402080303	A-1
15-25-11	Blane Creek	CAC	030402080303	A-1
15-25-11-1	Fox Creek	CAC	030402080303	A-1
15-25-11-2	Salt Boiler Creek	CAC	030402080303 030402080309	A-1
15-25-11-3	Bull Creek	CAC	030402080303	A-1
15-25-12	Little River	CAC	030402080303	A-1
15-25-12-1	Dead Backwater	CAC	030402080303	A-1
15-25-12-1-1	East River	CAC	030402080303	A-1
15-25-12-2	Bonaparte Creek	CAC	030402080303	A-1
15-25-12-3	Clayton Creek	CAC	030402080303	A-1
15-25-13	Calabash River	Prohibited	030402080302	A-1
15-25-13-1	Hangman Branch	Prohibited	030402080302	A-1
15-25d	Intracoastal Waterway	Prohibited; CAC	030402080303	A-1

Assessment Unit Number	Name	Growing Area Classification	Subwatershed	Growing Area
15-25f	Intracoastal Waterway	Prohibited	030402080303	A-1
15-25g	Intracoastal Waterway	CAC	030402080303	A-1
15-25i	Intracoastal Waterway	Prohibited	030402080303 030402080204	A-1
15-25j	Intracoastal Waterway	Prohibited	030402080204	A-1
15-25k	Intracoastal Waterway	CAO	030402080204	A-1
15-25l	Intracoastal Waterway	CAO	030402080204	A-1;A-2
15-25-2-(10)a	Shallotte River	Prohibited	030402080204	A-2
15-25-2-(10)b	Shallotte River	Prohibited	030402080204	A-2
15-25-2-(10)c	Shallotte River	Prohibited	030402080204	A-2
15-25-2-(10)d	Shallotte River	CAO	030402080204	A-2
15-25-2-11-(2)	The Mill Pond	Prohibited	030402080204	A-2
15-25-2-12-(2)	Goose Creek	Prohibited	030402080204	A-2
15-25-2-14	The Swash	CAO	030402080204	A-2
15-25-2-15-(3)	Shallotte Creek	CAO	030402080203	A-2
15-25-2-15.5	Gibbs Creek	CAO	030402080204	A-2
15-25-2-16	Saucepan Creek	Prohibited	030402080204	A-2
15-25-2-16-1-(2)	Jinnys Branch	Prohibited	030402080204	A-2
15-25-2-16-4-(2)	Goose Creek	Prohibited	030402080204	A-2
15-25m	Intracoastal Waterway	CAO	030402080204	A-2
15-25n	Intracoastal Waterway	CAO	030402080204	A-2
15-25n	Intracoastal Waterway	CAO	030402080204	A-2
15-25o	Intracoastal Waterway	CAO; Prohibited	030402080204	A-2
15-25p	Intracoastal Waterway	CAO	030402080204	A-2
15-25q	Intracoastal Waterway	Prohibited	030402080204	A-2
15-25r	Intracoastal Waterway	CAO; Prohibited	030402080204	A-2
15-25s	Intracoastal Waterway	CAO	030402080204	A-2
15-25t	Intracoastal Waterway	CAO	030402080204 030402080107	A-2;A-3
15-25-1-(16)a	Lockwoods Folly River	Prohibited	030402080106	A-3
15-25-1-(16)b	Lockwoods Folly River	Prohibited	030402080106	A-3
15-25-1-(16)c	Lockwoods Folly River	Prohibited	030402080106	A-3
15-25-1-(16)d	Lockwoods Folly River	CAO	030402080106	A-3
15-25-1-18-(2)	Mill Creek	Prohibited	030402080105	A-3
15-25-1-19	Mullet Creek	Prohibited	030402080106	A-3
15-25-1-20	Lockwoods Creek	Prohibited	030402080106	A-3
15-25-1-21	Spring Creek	CAO	030402080106	A-3
15-25u	Intracoastal Waterway	Prohibited	030402080107	A-3
15-25v	Montgomery Slough	Prohibited	030402080107	A-3

Contact the ***Department of Environmental Health*** to get the latest classifications and closures. Shellfishing closures are enforced by the ***Division of Marine Fisheries***.

Table 5-2: Number of Benthic and Ambient Site in the Long Bay Subbasin by 10-Digit Watershed

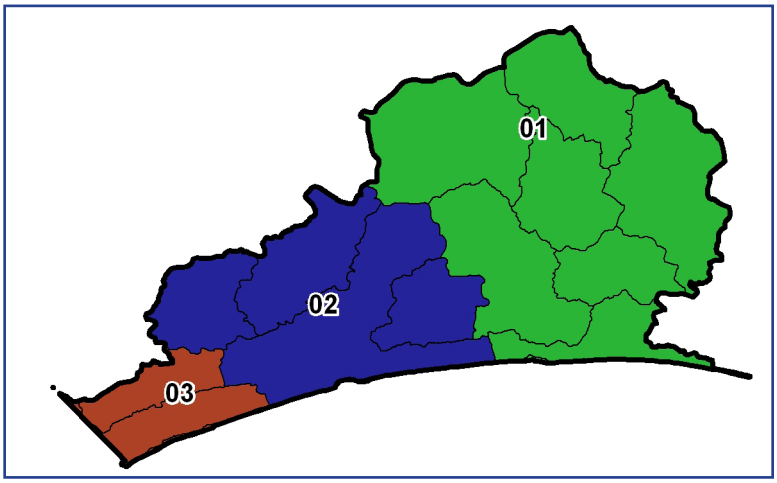
10-Digit HUC	Name	Square Miles	Benthic Sites	Ambient Sites
0304020801	Lockwoods Folly	146.5	1	10
0304020802	Shallotte River	84.7	1	3
0304020803	Little River	*21.2	0	2

*Denotes HUC is only partially in North Carolina and the area was only calculated for that portion.

Local Water Quality

Table 5-2 list the number of benthic and ambient monitoring sites that were sampled for the 2002-2006 assessment period by watershed (10-Digit HUC). There are three watersheds and fifteen subwatersheds in the subbasin. Figure 5-4 shows the location of these watersheds which are labeled with the last 2 digits of the 10 digit HUC.

Figure 5-4: 10-Digit HUCs in the Long Bay Watershed



Lockwoods Folly River (0304020801)

In 2007, the DWQ Watershed Assessment Team completed a water quality study in the Lockwoods Folly River watershed as part of an agreement with the Ecosystem Enhancement Program. This report is a summary of the data collected by DWQ in this watershed prior to September 2005. Also in 2007, a local watershed plan for the Lockwoods Folly watershed was created by the North Carolina Coastal Federation, NC Ecosystem Enhancement Program, NC Department of Transportation, the NC Shellfish Sanitation Program, and Stantec. This project received funds from the Nonpoint Source 319 Grant Program. The Lockwoods Folly Local Watershed Plan can be found at: ***http://www.nceep.net/services/lwps/Lockwood/Lockwoods%20Folly%20DA-TM%20Report%20Final.pdf***.

A new regional WWTP, called the West Brunswick WWTP, was constructed in the watershed and is expected to service the needs of the entire watershed. The regionalization of this plant was funded in part by a grant from the CWMTF. In late 2008, this facility's non-discharge permit limit was increased from approximately 3 MGD to approximately 6 MGD. The effluent from this plant is sprayed over 854.47 acres of fields and golf courses. A countywide study is needed to plan for increased spraying of treated wastewater in the area. The Brunswick County CAMA Land Use Plan projects that seasonal wastewater flows in Lockwoods Folly watershed will exceed 6 MGD by 2015.

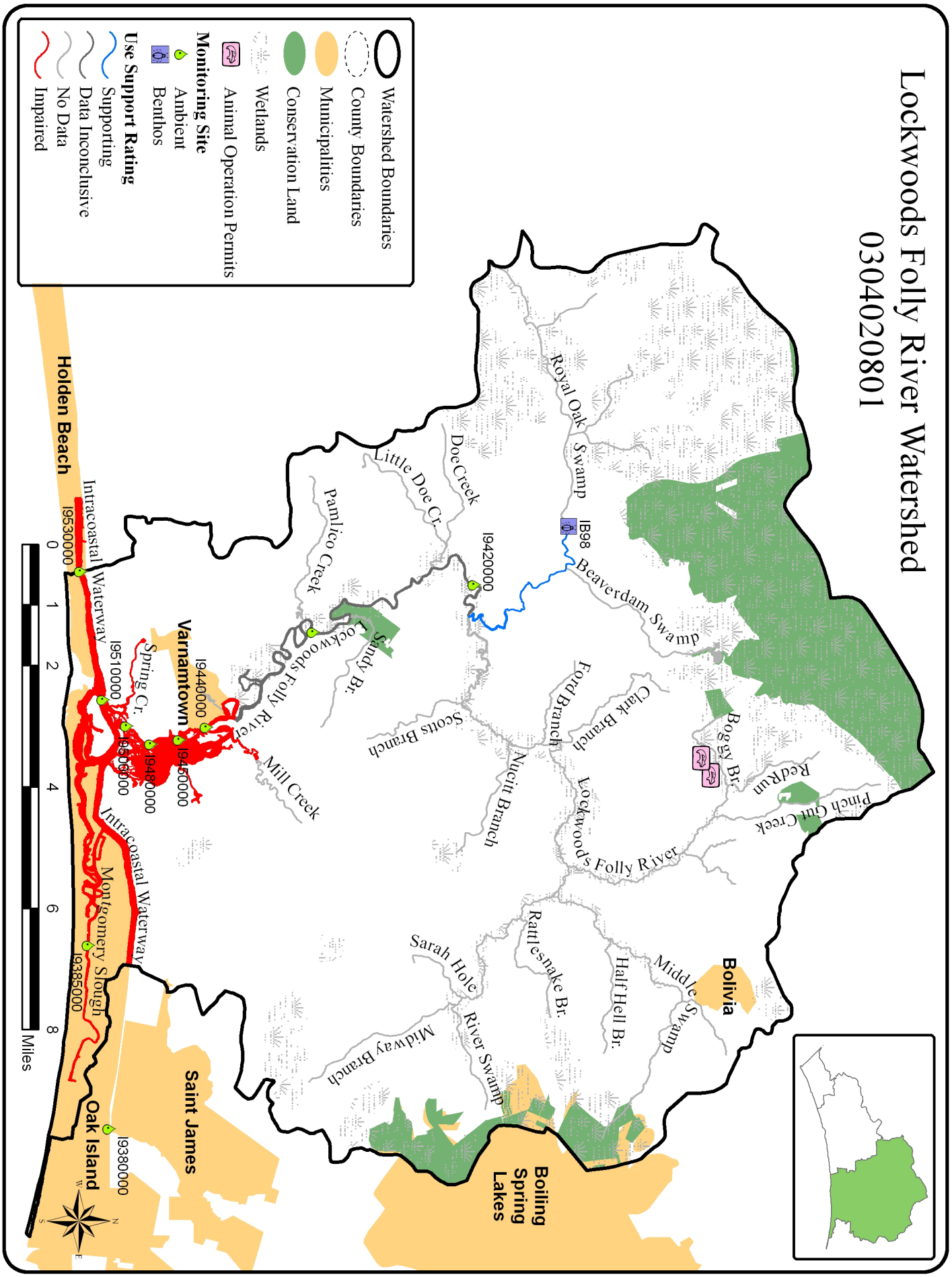
Middle Swamp (030402080101)

Middle Swamp subwatershed is part of the Ecosystem Enhancement Program's Targeted Local Watershed (03040207020010). It also contains part of the Boiling Spring Lakes Plant Conservation Preserve. Samples taken from Bolivia Branch AU # 15-25-1-6-4-1 for development of the Lockwoods Folly Local Watershed Plan were found to have high concentrations of nutrients. It is thought that the cause is a former discharger that ceased operation in October of 2006.

Lockwoods Folly River Headwaters (030402080102)

This subwatershed contains part of the Green Swamp Preserve. It is also part of the Ecosystem Enhancement Program's Targeted Local Watershed (03040207020010). In 2008, as part of the EEP Plum Creek Project, 80 acres of nonriverine wetlands were restored and 6 acres adjacent to Boggy Branch AU # 15-25-1-2-1 were enhanced. Mitigation included the plugging of ditches and the planting of natural vegetation. This site will be monitored for 5 years to determine if the restoration efforts were successful.

FIGURE 5-5: LOCKWOODS FOLLY RIVER WATERSHED (0304020801)



Royal Oak Swamp (030402080103)
Royal Oak Swamp subwatershed has been designated by the Ecosystem Enhancement Program as Targeted Local Watershed (03040207020020). This watershed contains part of the Green Swamp Preserve and much of the headwaters of Lockwoods Folly River.

Benthic macroinvertebrate sampling site IB99 is located at NC Highway 211, on Royal Oak Swamp AU # 15-25-1-12a. It was sampled for benthic macroinvertebrates in late winter since flow is usually highest in the watershed during the winter. It has received a natural rating in all 5 samples taken since 1996 and was used to help develop the swamp waters criteria. It was noted that pool variety and bottom substrate were poor due to increased silt deposition. This site serves as a reference site for freshwater benthic communities for the rest of the subbasin.

Royal Oak Swamp was last sampled for fish community health in 2001 when it showed a diverse and healthy community including the pollution intolerant Ironcolor Shiner, which was the most abundant specimen. As the headwaters of Lockwoods Folly River it is important to protect Royal Oak Swamp in order to prevent further degradation downstream in the impaired Lockwoods Folly River.

The Northwestern portion of this watershed is part of The Nature Conservancy's Green Swamp Preserve. There are two waterbodies in the preserve, The Green Swamp Small Depressional Pond and Big Island Savanna, that are supplementally classified as Unique Wetlands.

Scotts Branch-Lockwoods Folly River (030402080104)
Scotts Branch-Lockwoods Folly River subwatershed is part of the Ecosystem Enhancement Program's Targeted Local Watershed (03040207020010).

Mill Creek (030402080105)
Mill Creek subwatershed is part of EEP's Targeted Local Watershed (03040207020030)

Pamlico Creek-Lockwoods Folly River (030402080106)
The Pamlico Creek-Lockwoods Folly River Watershed is part of the Ecosystem Enhancement Program's Targeted Local Watershed (03040207020030).

There are five assessment units belonging to Lockwoods Folly River in this subwatershed. Four of the five are impaired and the remaining segment is Not Rated. Lockwoods Folly River AU # 15-25-1-(16) a,b,c, and d are all impaired due to shellfishing restrictions and segments b and c are on the 303(d) list for fecal coliform bacteria exceedances. Lockwoods Folly River AU # 15-25-1-(11) is currently Not Rated for low pH, low dissolved oxygen, and chlorophyll a. This segment was not impaired for chlorophyll a because there was an insufficient number of samples taken to make an accurate determination. It was not impaired for pH and dissolved oxygen because of possible interactions with adjacent swamp waters and tidal influences.

Where Sandy Branch AU # 15-25-1-14 meets Lockwoods Folly River AU # 15-25-1-(11) the North Carolina Coastal Land Trust placed a 259 acre tract of land into a permanent conservation easement. There are plans to install about a mile of trails, some parking, and restrooms for visitors seeking to enjoy Lockwoods Folly River and the adjacent floodplain.

Town of Long Beach-Montgomery Slough 030402080107
A portion of this subwatershed is part of EEP's TLW(03040207020040) and another portion is in EEP's TLW (03040207020050).

Montgomery Slough (AU # 15-25v), has been impaired for fecal coliform bacteria exceedances since 2006 and in 2008 it also became impaired for turbidity and low dissolved oxygen levels. It is currently on the 303(d) list for all of these parameters. Also of concern is that two out of six samples taken from ambient monitoring site

I9385000 exceeded the chlorophyll a standard. Montgomery Slough was not impaired for chlorophyll a because 10 samples are required.

Intracoastal Waterway segment AU# 15-25t was added to the 303(d) list for 2008 because water sample collected by the Division of Environmental Health had fecal coliform levels that exceeded the standard for shellfish harvesting.

The Town of Oak Island is in the process of connecting its residents to its sewer system thus eliminating several septic systems. Once collected this waste will be sent to the Brunswick County Regional Sewer System for treatment.

Town of Long Beach-Long Beach (030402080108)
The Atlantic Ocean (AU # 99-(1)) is impaired for fish consumption because of high mercury levels found in fish tissue samples.

Shallotte River Watershed (0304020802)

Most of the municipal limits of Shallotte, Ocean Isle Beach, and Holden Beach are within the Shallotte River Watershed (Figure 5-6). The only two NPDES wastewater discharge permits are minor and belong to oyster companies with a maximum daily discharge of 20,000 gallons/day.

Upper Shallotte River (030402080201)
Upper Shallotte River subwatershed is part of the Ecosystem Enhancement Program's Targeted Local Watershed (03040207020060).

Middle Shallotte River (030402080202)
Ambient monitoring site I9700000, on the Shallotte River AU # 15-25-2-(7.5), had the highest fecal coliform geometric mean with 444 colnies/100mL. The Middle Shallotte River was not impaired for recreation because it is classified as SC. Middle Shallotte River subwatershed is part of the Ecosystem Enhancement Program's Targeted Local Watershed (03040207020060).

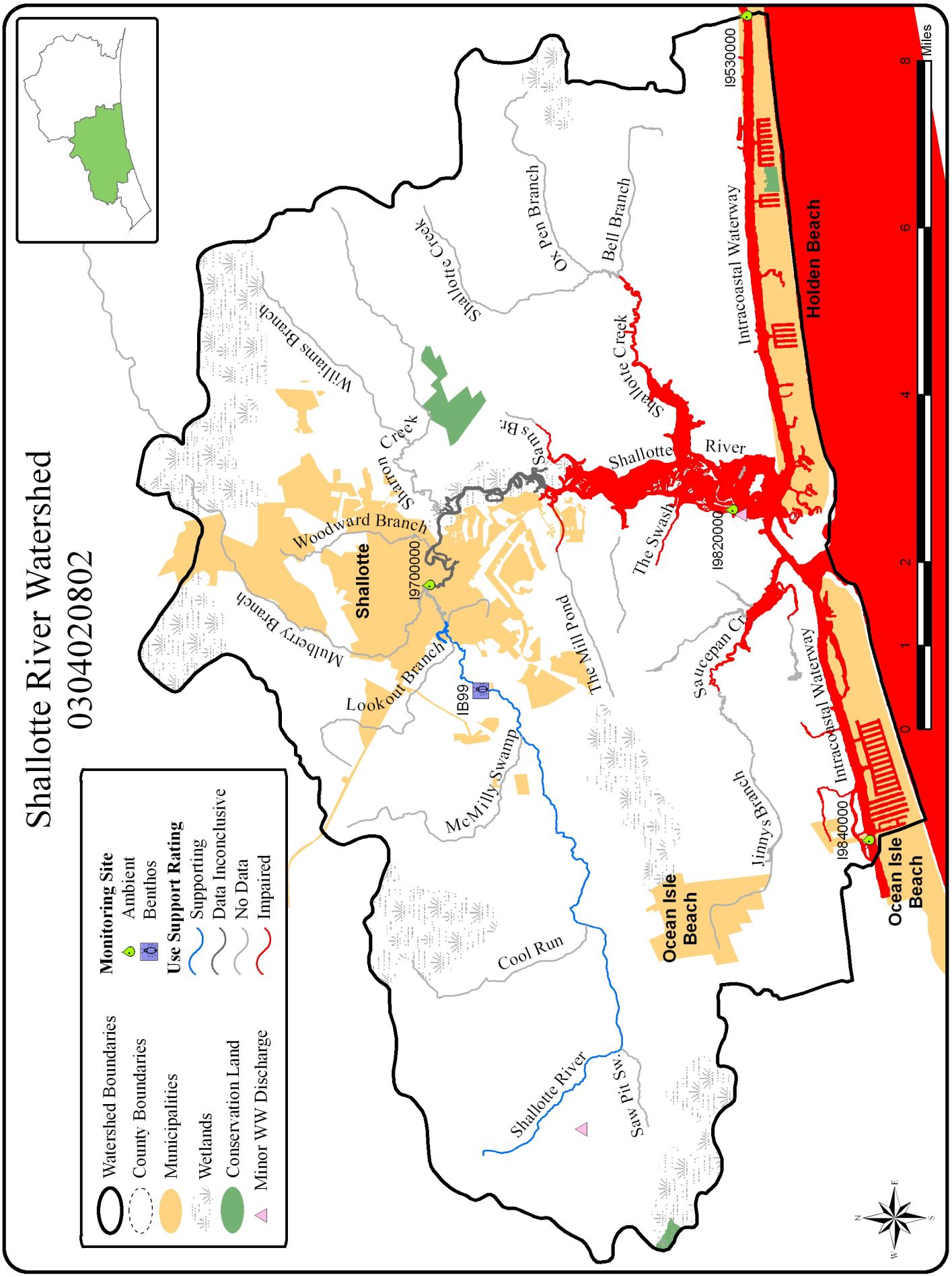
Benthic macroinvertebrate station IB99, located on the Shallotte River AU# 12-25-2-(1), was sampled as part of a special study in 2003. The study was conducted to determine if a Fair bioclassification rating received in 2001 was accurate or due to drought. The study resulted in a Good-Fair bioclassification rating but has now been dropped from regular sampling because of high salinity from saltwater intrusion.

Shallotte Creek (030402080203)
Shallotte Creek AU # 15-25-2-15-(3) is currently impaired due to frequent shellfish harvesting closures. This subwatershed is part of the Ecosystem Enhancement Program's Targeted Local Watershed (03040207020060).

Lower Shallotte River (030402080204)
A portion of this subwatershed is part of the Ecosystem Enhancement Program's Targeted Local Watershed (03040207020060) and another portion is part of TLW(03040207020090). A 224 acre conservation easement was donated to the North Carolina Agricultural Foundation, Inc. in December 2008. It is currently being maintain by the foundation as a nature preserve dedicated to research and education. This easement provides a buffer on one side of a small portion of Sharron Creek AU# 15-25-2-9-(1).

Shallotte River AU # 15-25-2-(7.5) is Not Rated due to pH and low dissolved oxygen levels, at ambient monitoring site I9420000, that were below standards in 41.1 and 12.7 percent of the time respectively. The river was not impaired for either parameter because swamp waters contributions and tidal influences are not fully understood. chlorophyll a sample exceeded the standard in 14.3 percent of the samples but this segment of the Shallotte River was not impaired because only seven samples were taken and 10 is required to make a determination.

FIGURE 5-6: SHALLOTTE RIVER WATERSHED (0304020802)



Shallotte River AU #s 15-25-2-(10) a,b,c, and d are all impaired for loss of shellfishing use. All of these segments are on the 303(d) list for fecal coliform bacteria levels that exceeded the standard for shellfishing waters, except AU # 15-25-2-(10)b.

Lyoyd's Oyster Company has a NPDES wastewater discharge permit to discharge treated wastewater to the Shallotte River AU# 15-25-2-(10)a. DWQ inspectors have noted that this facility needs to remove solids from their settling basin more frequently to maintain permit compliance.

Saucepan Creek AU# 15-25-2-16 is impaired for fecal coliform bacteria levels that exceeded the fecal coliform standard for shellfishing waters and is currently on the 303(d) list.

Intracoastal Waterway AU#s 15-25 i,p,t, and u are impaired for fecal coliform bacteria exceedances and are on the 303(d) list.

Holden Beach-Long Bay (030402080205)
The Atlantic Ocean AU# 99-(1) is impaired for fish consumption because of high mercury levels found in fish tissue samples.

Little River Watershed (0304020803)

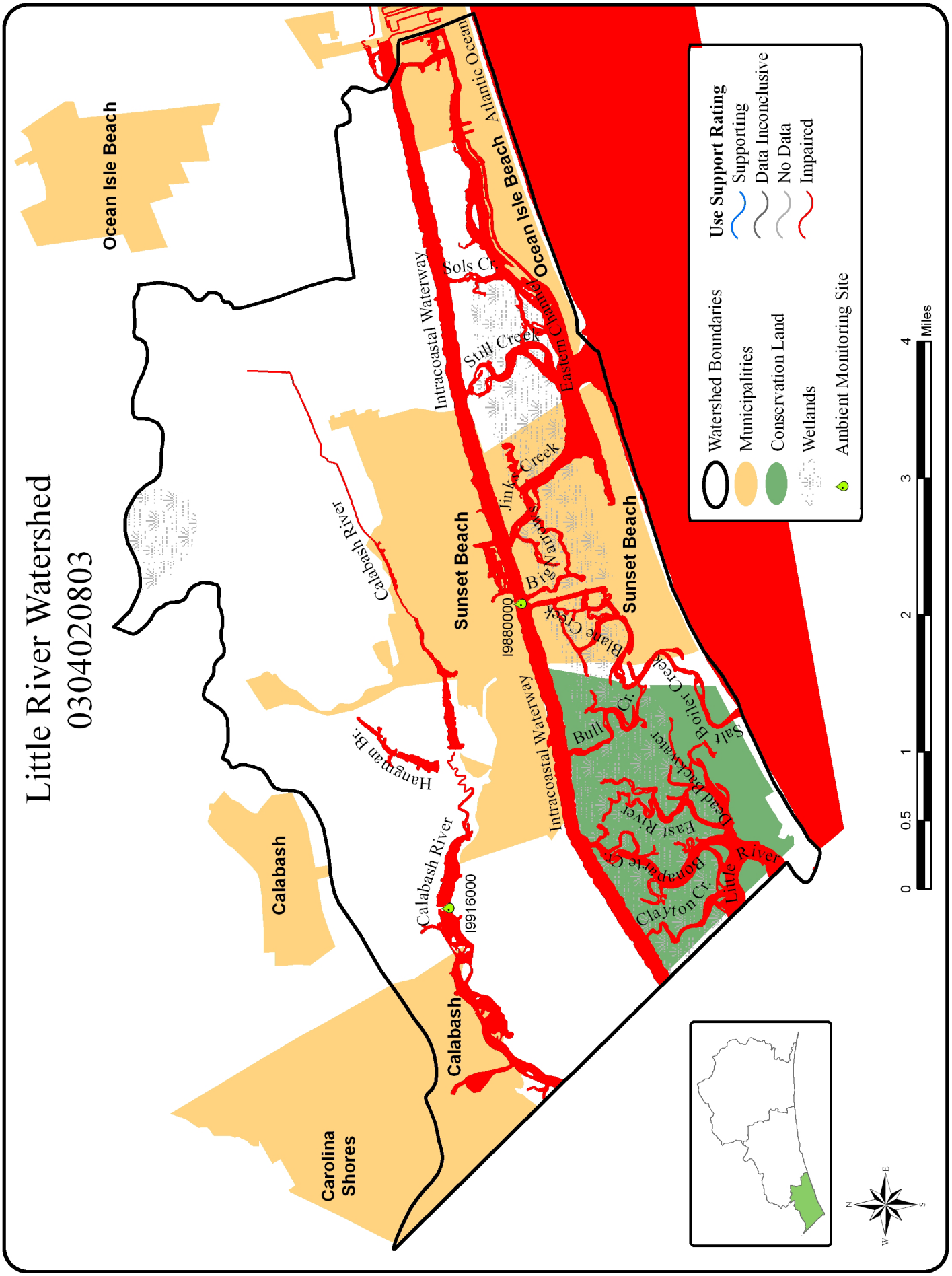
All assessed waterbodies in this watershed are impaired by the state of North Carolina, furthermore, eight assessment units are on the 303(d) list of impaired waters. The Towns of Calabash, Sunset Beach, and the western part of Ocean Isle Beach are found here (Figure 5-7). The Town of Calabash currently has a CAMA Land Use Plan that was completed in 2006 and is currently under review by the Division of Coastal Management.

A study was conducted in Southwest Brunswick County between October 1996 and October 2002 found that in the Little River watershed septic tanks are contributing to the bacteria load (Cahoon, 2006). Researches discovered evidence of lateral transport in areas that have a high density of septic tanks and sandy soil not suited for septic tanks. Brunswick County is currently installing sewer lines in these areas which include all areas of Sunset Beach that currently do not have sewer service. Residents with septic tanks are encouraged to connect to this system. Once completed the waste will be sent to the Sea Trails WWTP. Since much of Brunswick County's sewer systems are interconnected they will also have the option of sending the waste to either Shallotte WWTP or the West Brunswick Regional WWTF. These plants currently have enough additional capacity to accept the additional flow. This project is scheduled to be completed in June of 2011. Installation of the sewer line is not expected to increase impervious surface because the area being provided sewer is nearly built-out.

Calabash Creek (030402080302)
This subwatershed is part the Ecosystem Enhancement Programs Targeted Local Watershed (03040207020110). At just under 10 square miles, this subwatershed is the entire drainage area for the Calabash River. The Calabash River is particularly problematic because its drainage area, which includes the Town of Calabash, has steeper slopes than the rest of the watershed making it more susceptible to stormwater runoff. It is also shallow and tidal which results in regular mixing throughout the water column.

The Calabash River (AU # 15-25-13) was added to the 303(d) list for turbidity and copper. It remains on the list for fecal coliform and shellfish harvesting closures. Samples from ambient monitoring site I9880000, on the Calabash River, exceeded the standard for copper, fecal coliform, turbidity, and low dissolved oxygen. The turbidity and low dissolved oxygen exceedances may be due to tidal fluctuations. The site exceeded the standard for copper in forty-five percent of the samples. Potential sources of copper include runoff from boat cleaning, wood pressure-treated with chromium copper arsenate (CCA), brake dust from brake pads containing copper, as well as, algaecides and pesticides that contain copper.

FIGURE 5-7: LITTLE RIVER WATERSHED (0304020803)



Lower Little River-Atlantic Intracoastal Waterway (030402080303)
This subwatershed contains Bird Island which became part of the North Carolina Coastal Reserve in 2002. This undeveloped barrier island has approximately 136 upland acres and over 1,060 acres of marsh, intertidal flats, and subtidal area. Biotic communities found here consist of upper beach, dune grass, maritime dry grassland, maritime wet grassland, maritime shrub thicket, maritime shrub swamp, brackish marsh, salt shrub, salt flat, and salt marsh. The island serves as a nesting location for the Loggerhead Sea Turtle.

The Carolina Shores WWTP had two spills in 2004 caused by hurricanes. It is unknown what impact these incidents had on water quality in the Little River watershed.

Four segments of the Intracoastal Waterway are impaired in this subwatershed due to fecal coliform bacteria exceedances, including AU #s 15-25 d, f, g, and i, all of which are on the 303(d) list. Bonaparte Creek AU # 15-25-12-2 is also impaired for fecal coliform bacteria levels and is on the 303(d) list.

The mainland side of this subwatershed is part of the Ecosystem Enhancement Program's Targeted Local Watershed (03040207020110).

Tubbs Inlet-Long Bay (030402080309)
Madd Inlet, which is the mouth of Salt Boiler Creek AU # 15-25-11-2, is now shoaled over and prevents flushing of the estuarine waters. Tubbs Inlet, which separates Sunset Beach from Ocean Isle Beach, is partially shoaled over. Neither of these inlets are maintained by the United States Army Corp of Engineers because they are not considered major transportation paths.

Atlantic Ocean (030402080312)
The Atlantic Ocean (AU # 99-(1)) is impaired for fish consumption because of high mercury levels found in fish tissue samples.

Incentive Programs

Clean Water Management Trust Fund

Created in 1996, the Clean Water Management Trust Fund (CWMTF) makes grants to local governments, state agencies and conservation non-profits to help finance projects that specifically address water pollution problems. These projects include land acquisitions, capital improvements to wastewater and stormwater infrastructure, and stream restorations. Brunswick County was awarded a CWMTF grant in 2004 for the construction of new lines to connect the communities of Holden Beach and Winding River Plantation to the West Brunswick WWTP. A list of CWMTF Grants that have been funded through 2007 is provided in Table 5-3.

Table 5-3: CWMTF Grants Funded From 1997 - 2007 in the Long Bay Subbasin*

Project ID	Applicant	Purpose	Amount Funded	Total Cost
1998A-001	Town of Long Beach	Buffer Acquisition	$456,000	$956,590
2001A-019	NC Div. of Coastal Management	Buffer Acquisition	$2,750,000	$4,500,000
2002A-020	NC Coastal Land Trust	Buffer Acquisition	$652,000	$1,185,500
2004B-503	Brunswick County	Wastewater	$1,357,000	$12,294,000
Total	--	--	$5,215,000	$18,936,090

*Does not include statewide or regional grants.

North Carolina Agriculture Cost Share Program

Nonpoint source pollution is a significant source of stressors that lead to stream degradation. The approach taken in North Carolina for addressing agriculture's contribution to the nonpoint source water pollution problem is to primarily encourage voluntary participation by the agricultural community. This approach is supported by financial incentives, technical and educational assistance, research, and regulatory programs.

Table 5-4: BMP Installed through NCACSP between 2002 and 2006

BMP Implemented	Amount	Units	Cost
Long Term No-Till	147	Acres	$18,426
Cropland Conversion - Grass	99	Acres	$22,208
Grassed Waterway	1	Acres	$2,556
Waste Application Equipment	1	Units	$24,888
Total	--	--	$68,078

Table 5-5: Benefits Resulting from BMPs Installed through NCACSP between 2002 and 2006

Benefits	Amount	Units
Acres Affected	316	Acres
Soil Saved	509	Tons
Nitrogen Saved	2,472	Pounds
Phosphorous Saved	779	Pounds

Financial incentives are provided through North Carolina's Agriculture Cost Share Program. The Division of Soil and Water Conservation within the DENR administers this program. It has been applauded by the U.S. Environmental Protection Agency and has received wide support from the general public as well as the state's agricultural community. Table 5-4 shows the number of projects implemented and in the Long Bay subbasin and the dollar amount invested. Table 5-5 shows the water quality benefits realized from that investment.

Section 319-Grant Program

There have been two 319-grant funded project located within the Long Bay subbasin during the assessment period. Funded in fiscal year 2002, the North Carolina State University College of Design completed a study of ***Water Quality Impacts of Alternative Build-out Scenarios for Brunswick County, NC***. A second project was started by the North Carolina Coastal Federation to develop the Lockwoods Folly Water Quality Restoration TMDL. The Quality Assurance Project Plan (QAPP) for this project can be found on the ***319 Grant Program website***. These two projects received a total of $392,637 in funding from the 319-Grant Program.

NC Green Business Fund Grant

Clean Marine Solutions, a Wilmington North Carolina based company, was awarded a NC Green Business Fund grant of $84,602 by the ***North Carolina Board of Science and Technology*** for their innovative boat pressure washing system. This non-discharge wastewater treatment system is design to remove metals, such as copper, from the wastewater and reduce the amount of water needed for boat cleaning at marinas and boat yards.

Recommendations

Reduce Bacteria Loading
The Ecosystem Enhancement Program has developed a local watershed plan for the Lockwoods Folly River Watershed that specifically addresses the issue of bacteria loading. It identifies possible locations for stormwater retrofits and suggestions on future development. Local governments are encouraged to use this document as a guide for planning and developing local ordinances.

Increased and Improved Local Planning
Develop and implement local watershed plans for Shallotte River and for Calabash River similar to the local watershed plan for the Lockwoods Folly River. Improve CAMA Land Use Plans to place more emphasis on protecting water quality and strengthen implementation.

Low Impact Development (LID)
Brunswick County has the opportunity to become one of the leaders in the nation in design and implementation of low impact development. The Brunswick County Build-out Scenario study that was funded by the nonpoint source 319(h) grant program suggest alternative residential development practices that reduces impervious surfaces yet allows for an equivalent number of residences.

Reduce Copper in the Calabash River
Calabash River appears to have a problem with excessive amounts of copper. There are a variety of activities that could be contributing to increased copper concentrations. Activities involving boat maintenance are a possible source of copper to the river. Boat maintenance such as scraping, sandblasting, and painting should be done in a manner that prevents these materials from reaching surface waters [15A NCAC 7H.0208 (b)(5)(N)]. Runoff from pressure washing that reaches surface waters either directly or indirectly through stormwater drains is considered wastewater and requires permit [NCGS 143-215.1 (a)(6)]. Increased education, inspection, and enforcement of permits and water quality standards for these activities is needed to ensure that these activities are not contributing to copper levels in the river. Consumers are encouraged to use wood products and brake pads that contain no or low amounts of copper. The use of herbicides containing copper may be contributing to elevated copper concentrations. Better practices such as proper fertilization and buffers should be utilized to reduce the need for such herbicides in stormwater and amenity ponds.

Education
Increased education of local residents about boat cleaning practices and runoff should be continuous. Brunswick County is experiencing increased immigration so stormwater education should be a continuous process. Revitalization of the Clean Marinas Program with more emphasis on educating the public and marina owners about the program and why it is important is recommended.